

**POST-EGESTIVE SURVIVAL OF
SPHENOPHORUS PHOENICIENSIS CHITTENDEN
(COLEOPTERA: CURCULIONIDAE) EGESTED BY
WESTERN TOADS**

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Abstract.—Billbugs (Coleoptera: Curculionidae) are eaten by toads and egested alive in fecal pellets. This study examines post-egestive weight loss and survivorship of *Sphenophorus phoeniciensis* Chittenden after passing through the digestive tract of the western toad, *Bufo boreas* Baird & Girard. Weight loss (mg/h) in egested billbugs exceeds that found for nonegested billbugs at both low and high RH. Egested billbugs do not live as long as nonegested billbugs at the same relative humidity.

Key Words.—*Bufo boreas*, *Sphenophorus phoeniciensis*, Curculionidae, weevils, billbugs, fecal pellets, toads, survival

Toads (Bufonidae) are known to ingest billbugs (Coleoptera: Curculionidae). Some billbugs (*Sphenophorus* spp.) resist digestion by toads (*Bufo boreas* Baird & Girard) and emerge alive from fecal pellets (Barrentine in press). Egested billbugs have reduced survival at low humidities (Fair 1969). This is putatively due to increased water loss resulting from epicuticular damage. This study compares weight loss and survivorship between egested and nonegested billbugs (*Sphenophorus phoeniciensis* Chittenden) at both low and high relative humidities.

MATERIALS AND METHODS

Billbugs, *S. phoeniciensis*, in treatment samples were collected from infested turfgrass (2200–2300 h) and immediately fed to captive adult toads (*B. boreas halophilus* Baird & Girard). After two to three days, billbugs were isolated from freshly egested toad fecal pellets, individually weighed (0.1 mg) and then placed in one of two Scheibler desiccators. Both desiccators were kept at room temperature at 23° C, but differed in < 5% versus > 95% RH. Humidity was controlled using Drierite® (anhydrous calcium sulfate) or distilled water. Weight loss and survivorship of individual weevils were recorded at 24 h intervals. Because curculionids are capable of feigning death (DuPorte 1916, Weiss 1940), mortality was confirmed by lack of antennal reflex (flexor response to mechanical stimulation). After death, billbugs were oven dried at 68° C to constant weight. Billbugs in control samples were collected and handled as described above, for treatment samples, except that these were not fed to toads. Billbugs in treatment and control samples were paired by weight (± 0.1 mg, wet) before comparison using Student's *t*-test.

RESULTS AND DISCUSSION

At low humidity, there was no difference in weights between paired treatment and control samples at the time of death (Table 1). Although death weights were

Table 1. Weights of *Sphenophorus phoeniciensis* (mg, $\bar{x} \pm SE$).

	<i>n</i>	Wet weight (mg) $\bar{x} \pm SE$	Death weight (mg) $\bar{x} \pm SE$	Dry weight (mg) $\bar{x} \pm SE$
<5% RH				
Control	50	18.62 \pm 0.48	10.90 \pm 0.36	7.93 \pm 0.19
Treatment	50	18.62 \pm 0.48	11.28 \pm 0.39	7.89 \pm 0.19
>95% RH				
Control	50	18.57 \pm 0.54	12.68 \pm 0.35	} ^a 6.97 \pm 0.18
Treatment	50	18.57 \pm 0.54	15.44 \pm 0.53	

^a $t = 4.29$, $P < 0.01$.

similar for both samples (40%), billbugs in the treatment sample did not, on the average, survive as long as those in the control sample (Table 2). Mean weight loss for egested billbugs was 0.153 mg/h (7.34 mg/48.0 h) at < 5% RH. Mean weight loss in nonegested (normal) billbugs was 0.134 mg/h (7.72 mg/57.6 h). Assuming that weight loss is proportional to water loss, the desiccation rate for egested billbugs is 15% higher than that for normal billbugs at low humidity.

At high humidity, death weights between paired treatment and control samples differed (Table 1). Death occurred at 17% and 32% weight loss in treatment and control groups, respectively. Billbugs in the treatment sample did not, on the average, survive as long as those in the control sample (Table 2). Mean weight loss for egested billbugs was 0.022 mg/h (3.13 mg/144.5 h) at > 95% RH. Mean weight loss in nonegested (normal) billbugs was 0.020 mg/h (5.89 mg/295.7 h). Again, assuming that weight loss is proportional to water loss, the desiccation rate for egested billbugs is 10% higher than that for normal billbugs at high humidity.

These results both corroborate and extend observations made by Fair (1969). Fair observed that lowered humidity (39–43%) induced death in egested billbugs and that reduced survival was probably the result of increased water loss caused by damage to the epicuticle. This study thus documents reduced survivorship for egested billbugs at both low and high humidities and quantifies weight (water) loss for both egested and nonegested billbugs.

Table 2. Time of death for *Sphenophorus phoeniciensis* (hours, $\bar{x} \pm SE$ and range).

	<i>n</i>	Hours $\bar{x} \pm SE$	Hours (Min–Max)
<5% RH			
Control	50	57.6 \pm 1.81	} ^a (48–96)
Treatment	50	48.0 \pm 1.94	
>95% RH			
Control	50	295.7 \pm 17.07	} ^b (72–528)
Treatment	50	144.5 \pm 20.29	

^a $t = 3.58$, $P < 0.01$.

^b $t = 5.65$, $P < 0.01$.

LITERATURE CITED

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